ENGINEERING EDUCATION

Bulletin of the

Society for the Promotion of Engineering Education

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Chas. F. Scott, Mortimer E. Cooley, F. L. Bishop, *Editor.*

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FOREWORD. II.

BY CHARLES F. SCOTT,

President of the Society.

What Has Our Society Been Doing?

My rather general acquaintance with the operation of the Society during the past years and the more intimate information secured at the Secretary's office during the past summer, have led to the conclusion that the Society is rather ponderous and topheavy. In our general relations with other societies, in the work of our many standing committees, in the multitudinous general activities of the Secretary's office, there is a great deal being done of which the ordinary member has little knowledge and from which he receives little direct benefit. Without disturbing these formal and general activities of a few members, I propose, as explained in the September number of Engineering Education, that the membership at large shall have opportunity to carry out its fundamental purpose of promoting engineering education by promoting engineering teaching through the holding of Branch meetings in each institution.

It may, however, be serviceable for the members to run through the activities of the Society and to gain, as I have done, a perspective view and a better appreciation of its work.

The Constitution of the Society is quite general in character and has not been substantially modified for many years. The Council is the general executive body and consists of forty-eight members! About half attend the annual convention at which the only meetings of the Council are held, one of an hour and the other of a half hour. There is an Executive Committee of three, and a Publication Committee of three, in each of which the Secretary is the active member. These committees have held very few meetings, the business being conducted

by correspondence and consisting principally of the formal approval of proposals by the Secretary.

Organizations with which S. P. E. E. Coöperates.

The organizations with which we have formal and more or less definite coöperative relations together with the committees or officers through whom these relations are conducted are as follows:

Engineering schools (Institutional membership).
American Physical Society (Committee No. 13).
American Chemical Society (Committee No. 11).
American Council on Education (Society a member and 3 representatives on Executive Committee).
American Association for the Advancement of Science (Affiliated Society).
American Society of Civil Engineers (Committee No. 23).
American Society of Mechanical Engineers (Committee No. 23).
American Institute of Mining and Metallurgical Engineers. (Committee No. 23).
American Institute of Electrical Engineers. (Committee No. 23).
United States Bureau of Education (Secretary).
Joseph A. Holmes Safety Memorial (O. P. Hood, member of Committee).
American Mathematical Association (Committee No. 10).
American Association of Engineers (Secretary member of Committees).
Highway and Highway Transport Education Committee (Secretary a member of Executive Committee, also Treasurer).
Carnegie Foundation for the Advancement of Teaching (Survey).
Pan American Union (Exchange of publications and other information through Secretary).

Standing Committees of the Society.

The specific topics assigned to certain committees for the ensuing year follow the names of such committees.

1. Executive Committee: C. F. Scott, *Chairman,* Yale University, New Haven, Conn.; W. O. Wiley and F. L. Bishop.
2. Publication Committee: C. F. Scott, *Chairman;* M. E. Cooley and F. L. Bishop.
3. Program Committee: C. F. Scott, *Chairman;* H. J. Hughes, E. J. McCaustland, W. O. Wiley and F. L. Bishop.
4. Commitee on Committees: C. F. Scott, *Chairman;* H. J. Hughes, E. J. McCaustland, W. O. Wiley, F. L. Bishop, C. J. Tilden, H. S. Evans.
7. Institutional Committee: H. J. Hughes, *Chairman,* Harvard University, Cambridge, Mass.
8. Committee on Admission: O. J. Ferguson, *Chairman,* University of Nebraska, Lincoln, Neb.; L. L. Thurstone, L. P. Rondinella, C. E. Magnusson. Study of the methods of admission to engineering schools including European schools.
9. Committee on Production Engineering: John Airey, *Chairman,* University of Michigan, Ann Arbor, Mich.; W. H. Timbie, H. L. McGregor, B. W. Benedict, Hugo Diemer.
10. Committee on Mathematics: E. R. Hedrick, *Chairman,* University of Missouri, Columbia, Mo.; E. V. Huntington, H. C. Van Buskirk. Coöperate with the National Committee on mathematical requirements under the auspices of the Mathematical Association of America.
11. Committee on Chemistry: Joint Committee American Chemical Society. S. P. E. E. R. M. Bird, *Chairman,* University of Virginia, University, Va.; J. H. James and J. R. Withrow.
12. Committee on English: J. Raleigh Nelson, *Chairman,* University of Michigan, Ann Arbor, Mich.; W. O. Birk, F. E. Seavey.

13. Committee on Physics: W. S. Franklin, *Chairman,* Mass. Inst. of Tech., Cambridge, Mass.; G. W. Stewart, D. C. Miller. Coöperate with the teaching committee of the National Research Council and teaching committee of American Physical Society.
14. Committee on Business Training: Morris Knowles, *Chairman,* Jones Law Bldg., Pittsburgh, Pa.; A. B. McDaniel, P. F. Walker, W. E. Wickenden and W. E. Mott.
15. Committee on Civil Engineering: A. H. Blanchard, *Chairman,* University of Michigan, Ann Arbor, Mich.; Brig. Gen. C. H. Mitchell, H. S. Boardman, H. J. Hughes, Frederic Bass.
16. Committee on Mechanical Engineering: W. T. Magruder, *Chairman,* The Ohio State University, Columbus, O.; Walter Boyle and F. C. Wagner. A study of the relative amount of time given to prime movers.
17. Committee on Electrical Engineering: H. E. Dyche, *Chairman,* University of Pittsburgh, Pittsburgh, Pa.; W. H. Timbie, F. A. Fish and T. R. Rosebrugh.
18. Committee on Mining Engineering: J. B. Porter, *Chairman,* McGill University, Montreal, Canada.
19. Committee on Drawing: R. S. Kirby, *Chairman,* Yale University, New Haven, Conn.; T. E. French, W. N. Barnard, E. C. Chillman.
20. Committee on Standardization of Technical Nomenclature: J. T. Faig, *Chairman,* Ohio Mechanics Institute, Cincinnati, Ohio; W. D. Ennis, S. E. Moss, R. L. Daugherty, J. E. Emswiler.
21. Committee on R. O. T. C.: P. F. Walker, *Chairman,* University of Kansas, Lawrence, Kans.; C. R. Mann, Anson Marston.
22. Committee on Intelligence Tests: L. L. Thurstone, *Chairman,* Carnegie Institute of Technology, Pittsburgh, Pa.; Wm. T. Magruder, C. R. Dooley.
23. Committee to Coöperate with National Engineering Societies: Ira N. Hollis, *Chairman,* A.S.M.E., Worcester

Polytechnic Institute, Worcester, Mass.; D. C. Jackson, A.I.E.E.; J. C. Tracy, A.S.C.E.; F. W. McNair, A.I.M. & M.E.

24. Committee on Engineering Experiment Stations: C. S. Howe, *Chairman,* Case School of Applied Science, Cleveland, Ohio; P. F. Walker, F. L. Bishop, R. H. Fernald, J. F. Hayford.

Principal Functions of the Secretary's Office.

The Secretary is not the passive executive officer of the Society, merely carrying out the direction of a frequently meeting governing board, but he is the active officer, alone conversant with the Society's affairs, not only carrying out the general policy laid down by the Council, but individually conducting the routine work and handling with his own initiative and judgment many matters which are presented to the Society for action during the year.

Among the duties which are performed by the Secretary are the following:

Editing and issuing the monthly bulletin—Engineering Education.

Editing and issuing the bound volume of the Proceedings of the annual meeting.

Printing of the Bulletin, the Proceedings, the Information folder, reprints, etc.

Securing advertising for the Bulletin.

Collection; dues, advertising and sale of publications.

Keeping all books.

Membership campaign.

Membership list; resignations; corrected mailing list.

Issuing year book.

General correspondence with Society's committees; mimeographing of reports and distributing them at direction of committees.

New members.

General correspondence.

Sections: Correspondence.
Engineering teachers; clearing house for teachers of engineering; list of teachers available, etc.
Clearing house for information on engineering education; requests from various sources.
Representation of Society at educational gatherings and celebrations.

During the past year the Secretary's honorarium of $1,000 was considerably exceeded in meeting traveling and other expenses on behalf of the Society.

Comment on Present Organization.

This summary presentation of the things the Society is doing indicates how much is being done with very little executive machinery and at very little cost to the Society. I have been of those who believed that the Society was not accomplishing what it should. But how much should we expect when we pay less than a cent and a half a day in dues; when our institutional members (paying engineering instructors tens of thousands of dollars in salaries) pay only $10 ($25 is expected in the future) in dues to promote the efficiency of Engineering Education; when our administrative council of half a hundred, including more than a score of Past Presidents, is inherently cumbersome and dignified, but not alert and effective; when the burden of activities is carried as an overload by a Secretary who is an active Dean of an Engineering School; when we have passively awaited reports of conferences and committees and investigations and questionnaires to tell us what ought to be done, and have not earnestly undertaken the study of how to teach engineering and to train engineers?

A Full-Time Secretary.

Should we not reconsider what the Society should do and how it should do it? Is there not need for a general recon-

struction in its administrative organization? The original idea of the Society was a splendid one, namely, that professors could get together once a year and talk about their problems. But engineering has changed and engineering education has changed in thirty years. We must adopt new methods for meeting new conditions.

A full-time Secretary, an expert in the teaching of engineering as well as an executive and a man of vision, with an adequate staff of editorial and other assistants would enable the Society to exert an influence upon Engineering Education more in keeping with its opportunity and its obligation. He should attend meetings of sections and visit institutions, developing the Society from within as well as considering its outward relations and the general trend in educational and engineering affairs.

The change in secretaryship is not a question of next month, but it should be brought at the earliest possible date. The fundamental problem underlying this and other needed activities—and there are many—is funds. Our present budget is a little over $9,000. We need several times as much for headquarters and publications. Looking at the matter broadly, if we can really promote engineering education, have we not ample grounds for asking for the necessary means? If the Society promotes the teaching efficiency and the money value of the instructor is it not worth much more than the present dues? If it stimulates an engineering faculty to more effective teaching and suggests methods and laboratory appliances which may be the most economical is it not worth to an engineering school at least 1 per cent. of what it pays in engineering salaries? If it enables schools to produce better graduates would not the industries and public utilities which are dependent upon competent engineers and which now are at large expense in selecting and training college men, be justified in investing in the promotion of engineering education? If it advances the well being of Society at large by producing engineers of vision and ability to deal with its urgent problems, is it not fitting

that funds available for the promotion of the general welfare should be devoted to the promotion of engineering education? If we believe that we need money to carry out the high objects of our Society, should we not take measures to secure it?

I am proposing these questions to our members and officers for consideration and action.

(A reading of the page proof of this issue reveals the happy accident in arrangement which makes the first sentence of President Hadley's address of welcome at the last convention follow immediately after the foregoing Foreword.)

ADDRESS OF WELCOME.

BY ARTHUR TWINING HADLEY,

President of Yale University.

No society ever had before it a larger and more urgent task than yours. The country has waked to the need of having skilled engineers of every kind in vastly greater numbers than it ever had before. Past methods of training in engineering, as in chemistry and almost every other form of applied science, have been adapted to the teaching of a relatively small body of students. We have not professors enough to train by these methods the large body of men the country demands, and cannot get them without withdrawing more first-rate men from practical work than we can afford, or think we can afford, to spare. For the first time in the nation's history we have to face the question of national education in its entirety. The problem is not what training would be best for the individual engineer, but what system of training will keep the ranks of the profession full now and hereafter. This is the question which societies like this must solve. Educational institutions can contribute their part toward its solution by showing how they can make their individual appliances do the most work. But the big question of adjusting the character of our education so that the supply of engineers shall equal the demand must be solved by bodies like this.

I shall not attempt to forecast the form which the solution will take, but I can clearly indicate one or two things about it. First and foremost, any system of education that will be wide enough to meet the national needs must expect more of the student than it does at present.

From bottom to top, our education is suffering from kindergarten ideas. The American student has been ac-

customed to get too much help. He relies on the teacher to such a degree as to lessen the teacher's efficiency. He has been so much coddled in the early years of his schooling that when he comes to take up professional education and wants to work hard he often does not know how to do so if he would. Our army experiences in this respect were appalling. Thousands of American lives were lost in the last war because men who were otherwise qualified to be artillery officers could not do sums in logarithms straight unless they had a professor to help them.

Besides relying too much on the teacher we have, I think, made undiscriminating use of our laboratories. A laboratory can serve two or three quite distinct ends. It is a high grade manual training instrument which can teach the general student the use of hand and eye. It is a potent instrument of discovery where the investigator can find out things that were not known before. Each of these uses is admirable, and the more we can have of them the better. But there is another intermediate use which is not nearly so admirable —the use of laboratories for pseudo-discovery. From the kindergarten through high school and college to technical school, there are teachers who encourage a student to go through the motions of discovering a thing in order that he may remember the principle, and lead him to believe that if he has found out a principle for himself he has done better than if he found it out of a book.

I think that the overvaluation of this sort of amateur discovery is one of the worst features of American education. It is undoubtedly true that the use of physical and mechanical experiments makes it a great deal easier for boys to remember physical and mechanical laws. They pay an attention to the experiment that they do not pay to the book. But this does not prove that we can afford to excuse them from making the effort that is involved in intelligent reading. We can well allow a class an opportunity for one or two *illustrative* experiments. We can let a man see how sodium behaves under certain conditions. But it is a great waste of time to

have him repeat the same experiments about potassium and lithium and other things of the same sort because the really attentive reading of things that are set down in printer's ink is too much like work and too little like play.

A century ago we gave the pupil books and little else. There were very few schools indeed where he had much help either in the way of apparatus or of teaching. The men our schools produced were self reliant but uninstructed. But today there are many lines in which we go to the opposite extreme—giving them so much apparatus and instruction that they do not learn how to use books for themselves. Such men are instructed but not self reliant. This extreme is almost as dangerous as the other, and a great deal more expensive. It is for a society like this to find the middle course between the two extremes, which shall give enough help and not too much, which shall teach the pupil to use books for the things where books are needed, and laboratories for the things where laboratories are needed, and to use both of them for himself. In this way, and in this way only, shall we solve the problem of providing the country with the engineers that it needs with the forces at our command.

THE RELATIVE IMPORTANCE OF TOPICS IN SURVEYING INSTRUCTION.

BY W. H. RAYNER,

Assistant Professor of Surveying, University of Illinois.

The selection of the content of any curriculum is governed primarily by the value of the subject-matter, either to the individual or to society. But it is difficult to say as between the various topics to be considered in a curriculum, just what is the relative importance of each, and hence the degree of emphasis which it deserves. This condition imposes the need for more careful methods in this regard than have commonly been used, and we now have the benefit of some studies which may serve as aids in this work. Charters* has listed some five or six methods. One of these which is used in this study is described by Charters as follows:

"Another method of analysis of objectives is that of selecting subject matter on the basis of the common opinion of those engaged in using practical applications. Wilson and others attempted to determine the curriculum in arithmetic by collecting the opinion of business men as to which of the operations are of greater and less use in their businesses. These studies show where, in the opinion of the business men of the community, the greatest emphasis should be placed and where eliminations and additions might occur. Such methods should be used with the greatest caution because of the difficulty of obtaining the real judgments of practical men, who, being untrained in this sort of analysis are likely to make snap judgments.

"A more careful study in this method was made by a com-

* Charters, W. W., "What Has Thus Far Been Accomplished and Is Now Available for the Readjustment of School Curricula," University of Illinois, *Bulletin*, Vol. XVI., No. 12, pp. 27–30.

mittee of the Iowa State Teachers' Association which collected 5,036 problems in arithmetic reported upon by mature adults as having been met by them in their work. Reports were received from 457 persons, 41 per cent. of whom were housekeepers.

These problems were solved and the arithmetical processes used were tabulated and they show, among other things, that only simple operations are used and that the most frequently mentioned items were the four fundamental operations, fractions, United States money, accounts, percentage, buying and selling. It shows, also, the greatest use of these problems was made in connection with groceries, dry goods, fuel, labor, meat and clothing (probably due to the 41 per cent. of women reporting).

"Camerer has determined what bankers think should be known about banking by depositors, with a view to teaching this in the schools.

"Another appeal to the cumulated opinion of individuals is made by Bagley in defining the objectives of American history.

"All such appeals to the opinions of others must be conducted with unusual care to make certain that the real opinion is being recorded. It is doubtful if one can safely use any known device less laborious than that of the oral questionnaire. That is, the questionnaire should be prepared but the answers should be recorded by the investigator himself in an interview with the one questioned. The written questionnaire upon matters of opinion has been found to be unreliable and saving in time is not justified because of the inaccuracy of the results."

II. Statement of the Problem.

This study has for its purpose the determination of the relative value of topics which compose the subject-matter of elementary courses in surveying.

III. Procedure.

It will be noticed that Charters has indicated the danger in determining the opinions of individuals by the use of the written questionnaire. The danger cannot be denied where there is difficulty in establishing the exact point of view from which a judgment is made, and in making clear the idea on which a judgment is desired. This study, it is believed, has overcome this danger in two ways: first, the subject-matter is definite and is expressed in well standardized terms concerning which there is small chance for ambiguity or confusion; second, the point of view, "on the basis of my experience only," can be subject to but little misinterpretation in the case of practicing engineers. In the case of teachers where experience might include both practice of surveying and practice of teaching, the results show a consistency as great as, or even greater than that of the former group.

Since the subject-matter of surveying is well systematized in textbooks and field-manuals for students and practising surveyors, a large number of the topics to be evaluated, have been secured from this source; the author's own experience provided some additional material; and finally a few topics were added on the suggestion of practising engineers and teachers who answered a preliminary questionnaire, to be described later.

The selection of the topics to be compared, was made by the guidance of the following principles: first, only those topics were included, which were deemed important enough to justify the use of an hour's time in the classroom or field; second, the statements were made to be mutually exclusive in so far as possible; third, both the field and office practice of the surveyor were considered at all times; and fourth, only those topics were included which are fundamental to all branches of surveying practice.

According to these principles, the following text-books were carefully analyzed in listing the separate topics: "Principles

of Surveying," by Breed and Hosmer; "Plane Surveying," by John Tracy; "Theory and Practice of Surveying," by Johnson and Smith; "Plane Surveying," by Raymond; "Manual of Surveying for Field and Office," by Davis; "Surveying Manual," by Pence and Ketchum. This analysis, including the author's experience, yielded about one hundred and forty topics.

It was immediately evident that this number of topics could not be compared by each man addressed, and it would be necessary to make a division. This was done by classifying the topics according to the different instruments used in surveying work. An inspection of this classification showed that about one-half of the topics related to the transit and tape and the remainder related to the level, plane-table, miscellaneous instruments, and computations. Therefore, this division was used and these two sets of topics were sent out in separate letters, an equal number of each, to be judged by practising engineers and teachers.

A preliminary trial was made to answer these questions:

1. What proportion of engineers and teachers addressed, will reply?
2. Will the recipients rank the individual topics or will they group them only in five groups?
3. Have any important topics been omitted?

Forty-two letters were mailed out in this preliminary trial and seventeen replies were received which indicated that replies might be expected from about forty per cent. of persons addressed. Twelve individuals ranked each separate topic and five grouped them in the five groups only. This condition indicated clearly that if so large a per cent. were willing to rank the individual topics, it would be well worth while to insure that much additional care in making the comparisons by including that provision in the final form of the questionnaire.

Three topics only, were added to the original list as a result

of the request for suggestions of important topics which had been omitted.

In order to reduce the effort involved on the part of the recipient and to insure as careful ranking as possible, the following arrangement of the questionnaire was devised:

103 ENGINEERING HALL,
URBANA, ILLINOIS.

Dear Sir:—

The Civil Engineering Department of the University of Illinois is interested to know what subject matter, *i.e.*, what theory, field and office work should be given to students in surveying. Accordingly this department is seeking the cooperation of a large number of teachers and practising engineers and surveyors, of which you are one, to furnish us the benefit of your experience and advice. We shall deem it as a distinct favor if you will kindly devote the necessary time, perhaps an hour, to help us solve this important problem.

You will be asked to compare a number of topics pertaining to surveying work as regards their relative importance in courses in surveying. In comparing these topics "Importance" is to be judged on the basis of YOUR EXPERIENCE ONLY.

Enclosed you will find slips of paper on which are printed statements of the topics which pertain to the level, plane-table, and computations.* The same statements are also printed on whole sheets to facilitate comparison. In making your comparisons will you kindly follow these directions:

1. Read the statements on each sheet through carefully, so as to become acquainted with the character and range of the topics.

2. Group the slips in five groups under the headings printed on the five colored slips, which you will find enclosed and marked as follows: A = highest value; B = next to highest value; C = middle value; D = next to lowest value; and E = lowest value.

N. B. Please do not place more than 20 topics in any single group.

3. Rank the slips in each group by numbering the most important topic in that group as No. 1, the next important topic No. 2, etc. If there are two or more topics which you judge to be of equal importance, mark each of these with the same rank number.

4. Assemble the slips in each of the five bundles with its proper colored slip.

* In the parallel set this sentence read "transit and tape."

5. Fill out the enclosed information blank and mail together with the slips to the Department of Civil Engineering, University of Illinois, Urbana, Illinois.

I am,

Very sincerely yours,
W. H. RAYNER,
Assistant Professor of Surveying.

1001 How to measure a vertical angle. (field)
1002 How to make a compass survey of a field for area. (field).
1003 How to take a magnetic bearing. (field)
1004 How to survey, with a tape only, a field with a curved boundary. (field)
1005 How to stake out a bridge. (field)
1006 How to stake out a building. (field)
1007 How to locate established lot corners. (field)
1008 How to relocate lost corners.
1009 How to stake out a simple circular curve. (field)
1010 How to stake out a vertical curve. (field)
1011 The student should be given a thorough drill in the details of the construction of the transit; accompanied if practicable by inspecting the various parts.
1012 How to determine the probable error in sighting a flagpole at different distances. (field)
1013 The student should be given practice in pacing distances.
1014 The student should be made to thoroughly understand the function of the various parts of the engineer's TELESCOPE, *i.e.*, objective lens, cross-hairs, and eye-piece.
1015 How to rerun an old survey from a deed.
1016 How to make a survey of a field for a deed. (field)
1017 How to determine a true meridian by an observation on polaris at ELONGATION. (field)
1018 How to determine the stadia constants in the field.
1019 The student should be given a working knowledge only, of the stadia formulas.
1020 The student should be taught how to derive the stadia formulas.
1021 How to stake out sewer lines and grades. (field)
1022 The student should be given instruction in the proper handling and care of the instrument to protect it from injury. (does not refer to adjustments)
1023 How to set a transit at a point C which shall be on a straight line between two established points A and B which are not intervisible. (field)
1024 How to sub-divide regular and irregular sections of land.

1025 How to rerun established street lines. (field)
1026 How to stake out new lot lines.
1027 The student should be taught the sources and magnitude of the errors in stadia measurements.
1028 The student should be taught the sources and magnitude of errors in tape measurements.
1029 How to eliminate errors in tape measurements.
1030 How to correct a bearing for change in the declination of the needle.
1031 How to determine the declination of the needle. (field)
1032 How to keep transit notes. (field)
1033 How to measure distances, with tape only, past obstructions. (field)
1034 How to carry a transit line past an obstruction. (field)
1035 How to survey a field with a tape only. (field)
1036 The student should be taught the amount of error in transit work due to inaccurate setting over a point.
1037 How to adjust a compass-needle and pivot point. (field)
1038 How to lay off an angle by repetition. (field)
1039 How to prolong a line by the method of double sights. (field)
1040 How to meander a stream.
1041 How to stake out a new city sub-division. (field)
1042 How to determine a true meridian by direct observation with a transit on the sun. (field)
1043 The student should be taught what the judicial functions of a surveyor are in connection with land surveys.
1044 How to measure an angle by repetition. (field)
1045 How to determine the magnifying power of any telescope. (field)
1046 How to measure the height of a tower. (field)
1047 How to determine a true meridian by an observation on polaris AT ANY TIME. (field)
1048 The student should be taught the theory and use of the solar attachment to a transit. (field)
1049 How to eliminate the errors due to eccentricity in the verniers of a transit.
1050 How to run a random line with a transit. (field)
1051 How to run an azimuth traverse. (field)
1052 How to make the adjustments of a transit. (field)
1053 How to run an interior angle traverse. (field)
1054 The student should be taught what checks may be applied to a transit traverse. (field)
1055 The student should be taught what angular errors of closure may be expected in running a transit traverse.

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1056 The student should be taught just what effect each instrumental error due to bad adjustments in a transit, has on the various kinds of transit work.
1057 The student should be taught how to measure angles and erect perpendiculars with the tape. (field)
1058 How to run a deflection angle traverse. (field)
1059 How to measure the angle between two intersecting lines with a transit. (field)
1060 How to locate details with a transit and tape. (field)
1061 Take slope measurements in the field and reduce to the horizontal.
1062 How to read and determine the least count of any vernier. (field)
1063 How to compute bearings from angles and vice versa.
1064 How to use the transit when out of adjustment so as to eliminate errors.
1065 The student should be taught the common mistakes and errors in compass work.
1066 How to keep notes for transit-stadia work.
1067 How to stake out tile-drainage-ditch line and grades.
1068 How to stake out open-drainage-ditch line and grades.
1069 How to detect local attraction and to adjust a compass traverse.

INFORMATION BLANK

Name .....Date.....

Present Position .....

Business Address .....

Technical Education .....
College Course

Professional Experience: Please indicate below the number of years spent (a) in connection with actual surveying work and (b) in general engineering practice in one or more of the fields indicated.

1. Railroad surveys ..... yrs. 2. General railroad work ... yrs.
3. City surveys ..... yrs. 4. General city work ..... yrs.
5. Highway surveys ..... yrs. 6. General high work ..... yrs.
7. Drainage surveys ..... yrs. 8. General drainage work.... yrs.
9. Land surveys ..... yrs. 10. Miscellaneous surveys..... yrs.

11. Total number of calendar years in the practice of surveying.... yrs.

2001 How to make the adjustments of the plane-table alidade. (field)

2002 The student should understand clearly the effect on computed results of using the trigonometric functions of small angles.

2003 How to determine differences in elevation by trigonometric leveling, *i.e.*, by measured distances and a vertical angle. (field)

2004 How to compute cross-section areas.

2005 The student should be made familiar with the construction of the aneroid barometer.

2006 The student should be made familiar with the construction of the mercurial barometer.

2007 The student should be given practice in the computation of irregular areas; *e.g.*, trapezoids, and areas with curved boundaries.

2008 The student should be made thoroughly familiar with the degree of *accuracy* that may be expected in level circuits.

2009 The student should be given some practice in measuring slopes and elevations with the clinometer. (field)

2010 The student should be thoroughly drilled in the various checks to be applied to computations.

2011 How to compute areas by the method of coordinates.

2012 The student should be given a thorough drill in the systematic arrangement of computations.

2014 The student should be taught some of the common short cuts in computations.

2015 The student should be made to understand how many figures are significant and should be retained in computations.

2016 The student should be carefully advised regarding the advantages and limitations of slide-rule computations.

2017 How to set grade-stakes for railway, highway, street, sewer, or sidewalk construction. (field)

2018 How to compute areas by the method of latitudes and departures.

2019 How to plot a traverse by the method of total latitudes and departures.

2020 The student should determine the probable error of a single reading of a rod at various distances. (field)

2021 How to eliminate the various errors in leveling; *e.g.*, keep the lengths of backsights and fore-sights equal. etc.

2022 How to part-off a given area from a field.

2023 The student should be well practiced in making conventional signs for maps; such as, railways, highways, trees, grass, water-lines, contours, etc.

2024 The student should be made familiar with the details of construction of the plane-table instrument.

2025 The student should be well practiced in lettering.
2026 The student should be made to understand the sources and magnitude of errors in barometric leveling.
2027 The student should be made thoroughly familiar with the details of construction of the engineer's *dumpy* level.
2028 How to make the adjustments of the dumpy level. (field)
2029 The student should be given practice in running levels with the *hand level.*
2030 How to run a line of profile-levels. (field)
2031 How to correct for the curvature of the earth for unequal sights in leveling.
2032 How to keep the notes for transit-stadia levels.
2033 How to run a line of transit-stadia levels. (field)
2034 The student should be made thoroughly familiar with the details of construction of the engineer's *wye* level.
2035 How to make the adjustments of the wye level (not peg method). (field)
2036 How to run a "double rodded" line. (field)
2037 The student should be given a thorough understanding of the methods used in laying out the U. S. Public lands; including guide meridians, correction parallels, township exteriors and section lines.
2038 The student should be taught when it is advisable to use logarithms.
2039 How to plot details on a map.
2040 How to locate contour points on the plane-table map. (field)
2041 How to estimate earth-work from contour maps.
2042 The student should be given some drill in composing, arranging, and executing titles for drawings and maps.
2043 The student should receive practice in drawing contours on a plane-table map. (field)
2044 The student should be taught how the various kinds of corners in land surveys are marked.
2045 How to plot a traverse by the "chord" method.
2046 How to plot a traverse by the "tangent" method.
2047 How to keep cross-section notes. (field)
2048 How to keep profile level notes. (field)
2049 The student should be given practice in reproducing maps with the pantograph.
2050 The student should be given practice in determining areas with the planimeter.
2051 The student should be taught the advantages and limitations of the planimeter.

2052 How to perform the plane-table solution of the two-point problem. (field)

2053 How to perform at least one plane-table solution of the three-point problem. (field)

2054 The student should be given practice in making preliminary estimates of earth work from profiles.

2055 How to plot details on a profile.

2056 The student should be made thoroughly familiar with the simplest methods of computing earth-work quantities.

2057 The student should be made to understand clearly the *amount* of the various errors in leveling; such as, curvature of the earth, bubble not in center of tube, etc.

2058 How to level across a wide river or ravine. (field)

2059 How to locate points on the plane-table by the methods of intersection and resection. (field)

2060 The student should be made familiar with the details of construction of the various kinds of level rods.

2061 The student should be made familiar with the principles and construction of the sextant.

2062 How to read horizontal and vertical angles with a sextant. (field)

2063 How to use and interpret various map scales.

2064 How to supply "missing data" in a survey; *i.e.*, the bearing or distance of one side, etc.

2065 How to run a plane-table traverse. (field)

2066 The student should be made familiar with the various checks that may be applied to plotted traverses.

2067 How to determine the angular value of one division of a level tube. (field)

2068 How to set slope stakes and take cross-sections for earth work. (field)

2069 The student should understand clearly the regulations that exist between measured angles and measured distances to secure consistent accuracy in field work.

2070 How to determine the probable error of a series of measurements.

2071 How to use the level when out of adjustment, so as to eliminate errors.

A

On the basis of MY EXPERIENCE I judge the topics printed on the accompanying slips to be of the HIGHEST value in courses in Surveying.

B

On the basis of MY EXPERIENCE I judge the topics on the accompanying slips to be of NEXT TO HIGHEST value in courses in Surveying.

C

On the basis of MY EXPERIENCE I judge the topics on the accompanying slips to be of MIDDLE value in courses in Surveying.

D

On the basis of MY EXPERIENCE I judge the topics on the accompanying slips to be of NEXT TO LOWEST value in courses in Surveying.

E

On the basis of MY EXPERIENCE I judge the topics on the accompanying slips to be of LOWEST value in courses in Surveying.

From the tendencies indicated in the preliminary trial it seemed that some real conclusions could be based on two hundred replies, which indicated that the scope of the investigation should include some six hundred names.

The mailing list was made up of six hundred and ten names, four hundred and seventy practising engineers and one hundred and forty teachers. The names were selected from the year-books of the following societies: Society for the Promotion of Engineering Education; Illinois Society of Engineers; Colorado Society of Engineers; Connecticut Society of Civil Engineers; Iowa Engineering Society; Ohio Engineering Society; Kansas Engineering Society; Florida Engineering Society; Louisiana Engineering Society; American Society of Civil Engineers.

These lists were chosen to insure a wide geographical distribution even though it is well known that men in the profession of civil engineering are sure to represent experience gained in many quarters of the land.

The titles of the men in the various societies showed that the branches of civil engineering most frequently represented were the following; railway, city, land surveys, drainage, highway, and miscellaneous. A count was then made of the number of names belonging to each classification. The final list of names was then composed of a proper proportion from each class in an attempt to give each class its proper weight

in a composite judgment of all concerned. The information blank provided for a record of the duration of each man's experience in each branch, and the data secured is recorded below.

IV. Data.

1. **Number of Replies.**—One hundred ninety-nine persons returned the slips properly arranged. One hundred and one of whom ranked the topics relating to the transit and tape (serial numbers 1001 to 1069) and ninety-eight of whom ranked the topics relating to the level, plane-table, computations, etc. (serial numbers 2001 to 2071). These sets of ranked topics together with the facts on the Information Blanks constitute the data for this study.

2. **Record Slips.**—The rank order of the slips from each person was recorded on card-board slips. The blanks at the bottom of which were used to record the facts on the Information Blank. These data show in the case of John Smith (p. 15) that he attended the Sheffield Scientific School at Yale; his practice has included forty-nine years in city surveys; forty-nine years in land surveys, and represents a total practice of forty-nine calendar years. The words "Rank" and "Group" indicate whether the topics had been ranked individually according to direction No. 3 of the letter of instructions (p. 6) or whether the topics had been grouped only in the five groups. In the former case each topic represented by its serial number was given a different rank number, beginning with the most important topic as No. 1 and the least important topic No. 69 in one series and No. 71 in the other. In the case of the "grouped" arrangements, each topic in each group was given the same rank number; namely, that number which the middle topic for that group would have received in a continuous individual ranking. A sample record slip for each case is shown below.

FIG. 1.

Serial No.	Rank
1001	*28*
1002	*63*
1003	*63*
1004	*28*
1005	*10*
1006	*10*
1007	*10*
1008	*10*
1009	*41*
1010	*41*
etc.	

Mr. *John Doe*
Coll. *Iowa State*
Course *C.E.*
1 *3/4* 2
3 4
5 *3* 6 *2*
7 *5* 8 *4*
9 10
Total *8*
Rank Group √

Serial No.	Rank
2001	*59*
2002	*6*
2003	*39*
2004	*42*
2005	*68*
2006	*69*
2007	*13*
2008	*27*
2009	*53*
etc.	

Mr. *John Smith*
Coll. *Sheffield Sci. School*
Course
1 2
3 *49* 4
5 6
7 8
9 *49* 10
Total *49*
Rank √ Group

3. **Branches of Surveying.**—The record slips having been filled out, were then assembled in twelve bundles according to the different branches of surveying in which the men were mainly employed. The numbers belonging in the various branches were found to be as follows:

	Branch of Surveying.							
	Ry.	City.	High-way.	Drain-age.	Miscel-laneous.	Teach-ing.	All Except Teaching.	All.
Series 1000	11	16	14	14	28	18	83	101
Series 2000	10	20	14	8	21	25	73	98

The information which formed the basis for this grouping was (*a*) the title given by the men in the information blank, and (*b*) if this was not a clear indication, the slip was included in that branch to which it seemed to belong according

to the years of service in the various branches. It was found impracticable to make a group for land surveyors on account of the fact that very few men class themselves as such. This branch is best represented in the "Miscellaneous" branch, which includes all county surveyors, land surveyors and others whose practice had been so varied as not to justify inclusion in a distinct branch.

TABLE I.

SHOWING AVERAGE RANK OF TOPICS AS COMPUTED FROM SCORE-SLIPS. ALL BRANCHES EXCEPT TEACHING.

Series 1000.						Series 2000.					
Topic.	Rank.	Topic.	Rank.	Topic.	Rank.	Topic.	Rank.	Topic.	Rank.	Topic.	Rank.
1001	31	1026	31	1051	33	2001	50	2026	57	2051	39
2	45	27	39	52	13	2	36	27	39	52	54
3	33	28	29	53	39	3	34	28	30	53	52
4	49	29	25	54	33	4	17	29	41	54	23
5	27	1030	46	55	33	5	57	2030	9	55	23
6	31	31	41	56	30	6	60	31	47	56	15
7	28	32	10	57	41	7	20	32	27	57	36
8	23	33	35	58	31	8	28	33	25	58	39
9	21	34	24	59	23	9	53	34	26	59	47
1010	27	35	44	1060	27	2010	21	35	20	2060	47
11	32	36	35	61	36	11	37	36	48	61	58
12	49	37	52	62	40	12	22	37	27	62	57
13	40	38	40	63	26	13		38	39	63	30
14	32	39	25	64	33	14	33	39	22	64	32
15	25	1040	38	65	48	15	31	2040	44	65	41
16	23	41	32	66	29	16	35	41	29	66	35
17	40	42	40	67	32	17	12	42	35	67	52
18	45	43	30	68	31	18	25	43	44	68	14
19	43	44	32	69	51	19	27	44	34	69	27
1020	48	45	61			2020	42	45	42	2070	41
21	23	46	51			21	20	46	36	71	29
22	30	47	41			22	39	47	12		
23	22	48	46			23	32	48	12		
24	27	49	44			24	47	49	51		
25	25	1050	30			25	22	2050	37		

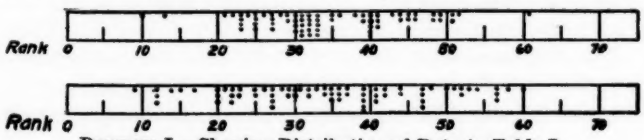

DIAGRAM I.—Showing Distribution of Data in Table I.

4. Average Rank of Topics.—From these record slips described and shown above, an average rank was computed for each topic. Table I shows these average rankings of topics by all except teachers. This table reads as follows: for the 1000 series, topic 1001 was given an average rank of 31, topic 1002 an average rank of 45, etc. Diagram I shows the distribution of the rankings given in Table I.

Table II and Diagram II show similar data for teachers only.

TABLE II.

SHOWING AVERAGE RANK OF TOPICS AS COMPUTED FROM SCORE-SLIPS. TEACHING BRANCH.

Series 1,000.						Series 2,000.					
Topic.	Rank.	Topic.	Rank.	Topic.	Rank.	Topic.	Rank.	Topic.	Rank.	Topic.	Rank.
1001	22	1026	45	1051	16	2001	43	2026	58	2051	51
2	43	27	30	52	14	2	37	27	28	52	50
3	31	28	19	53	30	3	38	28	16	53	40
4	45	29	20	54	22	4	22	29	40	54	33
5	43	1030	36	55	20	5	59	2030	8	55	30
6	39	31	46	56	29	6	62	31	45	56	22
7	41	32	10	57	34	7	33	32	23	57	50
8	42	33	35	58	19	8	24	33	23	58	41
9	31	34	23	59	17	9	49	34	27	59	34
1010	34	35	44	1060	23	2010	23	35	19	2060	51
11	40	36	37	61	42	11	33	36	43	61	54
12	58	37	54	62	17	12	20	37	40	62	53
13	30	38	35	63	19	13		38	35	63	38
14	31	39	15	64	20	14	44	39	29	64	36
15	44	1040	55	65	40	15	24	2040	34	65	30
16	39	41	34	66	22	16	40	41	36	66	28
17	29	42	35	67	42	17	22	42	42	67	46
18	35	43	39	68	45	18	21	43	36	68	21
19	37	44	19	69	48	19	23	44	47	69	22
1020	43	45	60			2020	43	45	52	2070	43
21	35	46	54			21	13	46	36	71	16
22	26	47	48			22	41	47	22		
23	9	48	54			23	48	48	12		
24	39	49	49			24	41	49	58		
25	45	1050	32			25	34	2050	38		

The diagrams show the interval between the ranks given to topics in different ranges of the series. Thus it is seen in Diagram I in the 1000 series, the rankings are closely grouped for the numbers from 30 to 35, whereas in the 2000 series we

find a more uniform distribution throughout the range of the scale.

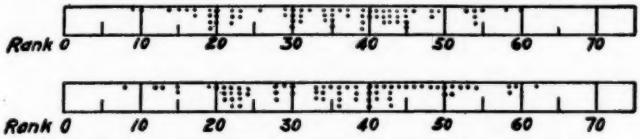

DIAGRAM II.—SHOWING DISTRIBUTION OF DATA IN TABLE II.

5. **Rank Order of Topics.**—By the use of the average ranks described above, the topics were put in a rank for each of the branches and numbered 1, 2, 3, etc., from the most to the least important topic.

The above procedure can best be made clear by the use of an example. Consider the two arrays *A* and *B*, as shown below. The topics *a*, *b*, *c*, *d*, and *e*, have been submitted to a number of judges for comparison. The average ranks which the topics received are shown under *A* to be 3.2 for *a*, 4.7 for *b*, etc. Therefore, when these topics are arranged in a rank order of importance as shown under *B*, obviously *c* is given first place, *d* is given second place, etc., until *b* is given last place.

A.		*B.*	
Topic.	Rank.	Topic.	Rank.
a	3.2	c	1
b	4.7	d	2
c	1.6	a	3
d	2.8	e	4
e	4.4	b	5

According to this procedure then each topic number in this study has two rank units; one as shown under *A*, and the other as shown under *B*. Reference to these different units will be made in the following pages by the use of the letters (*A*) or (*B*) to denote that unit to which reference is made.

It may be noticed that the rank orders, (*B*) in table III

TABLE III.

SHOWING RANK OF TOPICS IN SURVEYING INSTRUCTION AS JUDGED BY TEACHERS AND PRACTICING ENGINEERS.

Series 1,000.						Series 2,000.					
Topic.	18 Teachers (Rank).	83 Engineers (Rank).	Rank.	18 Teachers (Topic).	83 Engineers (Topic).	Topic.	25 Teachers (Rank).	73 Engineers (Rank).	Rank.	25 Teachers (Topic).	73 Engineers (Topic).
1001	13	29	1	1032	1032	2001	52	59	1	2030	2030
2	54	60	2	22	52	2	39	38	2	48	17
3	27	37	3	39	8	3	42	36	3	21	48
4	59	63	4	52	9	4	14	5	4	28	47
5	52	20	5	51	16	5	69	65	5	71	4
6	41	25	6	59	21	6	70	68	6	35	68
7	43	16	7	63	59	7	29	27	7	12	56
8	44	8	8	58	25	8	18	22	8	18	21
9	25	8	9	44	34	9	60	62	9	68	10
1010	28	21	10	1028	1039	2010	15	11	10	2047	2035
11	46	35	11	29	29	11	33	39	11	17	12
12	67	63	12	62	7	12	7	13	12	56	39
13	29	50	13	55	15	13			13	69	54
14	26	32	14	1	60	14	55	33	14	4	55
15	49	16	15	66	23	15	20	29	15	10	25
16	42	10	16	64	24	16	45	39	16	19	18
17	20	47	17	54	22	17	11	3	17	33	33
18	33	58	18	60	5	18	8	19	18	8	19
19	39	54	19	34	10	19	16	20	19	32	34
1020	53	61	20	1023	1043	2020	54	47	20	2015	2008
21	30	11	21	17	63	21	3	11	21	66	32
22	2	20	22	53	26	22	48	43	22	34	69
23	19	19	23	27	28	23	61	32	23	27	41
24	40	19	24	56	50	24	49	54	24	39	37
25	55	13	25	50	6	25	30	17	25	65	71
26	56	24	26	9	66	26	67	67	26	57	7
27	22	45	27	14	56	27	23	45	27	55	15
28	9	24	28	3	41	28	4	30	28	54	63
29	10	15	29	10	1	29	43	46	29	7	28
1030	36	57	30	10 13	1054	2030	1	2	30	2025	2023
31	57	52	31	21	68	31	37	50	31	59	14
32	1	1	32	33	67	32	19	22	32	40	64
33	31	35	33	38	64	33	17	19	33	11	66
34	18	14	34	18	58	34	22	22	34	64	3
35	15	54	35	57	44	35	6	12	35	41	42
36	37	38	36	42	14	36	53	54	36	43	2
37	65	66	37	30	11	37	44	26	37	38	46
38	32	47	38	36	33	38	37	40	38	46	11
39	3	14	39	43	51	39	24	13	39	2	16
1040	64	44	40	1019	1055	2040	32	50	40	2050	2038
41	51	28	41	24	3	41	35	25	41	63	57
42	36	47	42	6	36	42	50	50	42	3	44
43	39	20	43	16	61	43	36	35	43	29	58
44	9	32	44	7	53	44	59	41	44	37	22
45	69	69	45	8	40	45	66	50	45	16	50
46	65	64	46	65	27	46	38	38	46	53	51
47	62	50	47	11	17	47	10	4	47	58	27
48	67	58	48	61	42	48	2	3	48	22	29
49	63	56	49	67	38	49	68	64	49	24	20

Series 1,000.						Series 2,000.					
Topic.	18 Teachers (Rank).	83 Engineers (Rank).	Rank.	18 Teachers (Topic).	83 Engineers (Topic).	Topic.	25 Teachers (Rank).	73 Engineers (Rank).	Rank.	25 Teachers (Topic).	73 Engineers (Topic).
1050	25	24	50	1015	1062	2050	40	44	50	2042	2065
51	5	35	51	41	57	51	56	44	51	70	70
52	4	2	52	35	47	52	62	65	52	1	40
53	22	43	53	5	13	53	46	64	53	36	45
54	17	29	54	20	31	54	28	14	54	20	43
55	13	35	55	2	19	55	27	15	55	14	31
56	24	29	56	25	35	56	12	7	56	51	60
57	35	50	57	26	49	57	26	40	57	31	24
58	8	31	58	31	30	58	47	41	58	67	36
59	6	11	59	69	18	59	31	56	59	44	59
1060	18	17	60	1004	1048	2060	63	52	60	2009	2001
61	48	40	61	68	2	61	65	66	61	23	67
62	12	49	62	47	20	62	64	65	62	52	9
63	7	23	63	49	65	63	41	29	63	60	49
64	16	31	64	40	12	64	34	33	64	62	53
65	46	62	65	46	4	65	25	49	65	61	52
66	15	26	66	37	46	66	21	34	66	45	5
67	49	30	67	48	37	67	58	60	67	26	62
68	61	29	68	12	69	68	9	6	68	49	61
69	59	67	69	1045	1045	69	13	22	69	5	26
1070						2070	51	49	70	2006	2006
						71	5	26			

are somewhat different from the arrangement that would be expected from the average ranks (A) given in tables I and II. This condition results from weighting the rank averages (A) according to the average deviations from the mean of the individual scores. In other words, if two topics have the same, or nearly the same average rank (A), that one will be given a higher ranking (B), which has the lowest average deviation.

The results of these computations and rankings are shown in table III. Table III reads: topic 1001 was given a rank of 13 by 18 teachers, and a rank of 29 by 83 engineers of all branches "except teaching." The same information arranged to compare the various "topics" is shown in columns 4, 5 and 6, and is read as follows: first rank was given to topic 1032 by the eighteen teachers, also by the eighty-three engineers, etc.

TABLE IV.

Summary of Experience.

I.

For Men Reporting on Topics Relating to Transit and Tape, Nos. 1001–1069

Kind of Surveying Work.	Branch of Surveying.						
	Railway, 11 Men, Years.	City, 16 Men, Years.	Highway, 14 Men, Years.	Drainage 14 Men, Years.	Miscl., 28 Men, Years.	Teaching, 18 Men, Years.	Total, 101 Men, Years.
1. Railway surveys	**110**	14	31	10	25	20	210
2. Railway general	**166**	3	61	24	13	7	247
3. City surveys	13	**97**	27	48	104	14	303
4. City general	2	**82**	34	57	109	2	286
5. Highway surveys	0	39	**60**	12	34	4	149
6. Highway general	0	54	**64**	16	49	2	185
7. Drainage surveys	1	40	15	**101**	40	2	199
8. Drainage general	0	31	33	**162**	51	0	277
9. Land surveys	23	64	26	58	**151**	8	330
10. Miscellaneous	10	56	66	99	**105**	22	358
11. Teaching						**155**	155
Total calendar years of experience	159	174	195	169	383	195	*1,275

II.

For Men Reporting on Topics Relating to Plane-table, Level, etc. Nos. 2001–2070.

Kind of Surveying Work.	Branch of Surveying.						
	Railway, 10 Men, Years.	City, 20 Men, Years.	Highway, 14 Men, Years.	Drainage, 8 Men, Years.	Miscl., 21 Men, Years.	Teaching, 25 Men, Years.	Total, 98 Men, Years.
1. Railway surveys	**41**	14	10	3	50	22	140
2. Railway general	**108**	19	17	13	33	30	190
3. City surveys	2	**143**	9	5	138	38	385
4. City general	5	**247**	42	10	125	25	454
5. Highway surveys	9	3	**46**	4	51	76	189
6. Highway general	10	9	**69**	10	41	4	143
7. Drainage surveys	1	24	12	**37**	62	12	148
8. Drainage general	5	22	14	**36**	79	25	181
9. Land surveys	11	86	23	15	**185**	48	368
10. Miscellaneous	41	54	38	20	**152**	53	338
11. Teaching						**220**	220
Total calendar years of experience	211	391	162	107	372	372	*1,615

Note.—This total is the sum of the horizontal row of totals and is not equal to the sum of the vertical column of totals because of overlapping experience in the different branches.

6. **Experience Record.**—The number of years of service on which the rankings are based is summarized in table IV. The preponderance of years of service in the various branches is indicated by the heavy numerals. A comparison between these figures and the other figures of a vertical column for a given branch of surveying indicates the amount of overlapping in the practice of the men in that branch.

V. Analysis of Data.

1. **Validity of Method of Scoring.**—It will be well in our analysis first of all, to examine the propriety of the method used in ranking the topics in the cases of those men who assembled the slips in groups only. The method used is based on the assumption that each man judged the topics in each group as being of equal importance, or as having such slight variability in importance as to make it difficult to rank the individual topics. A different assumption might be made, however, that the men had quite definite opinions that the topics differed greatly in importance, but failed to make the individual rankings on account of a lack of time or inclination, or by an oversight of direction No. 3 in the letter of instruction (p. 6). If this assumption is the true one, the method used would be seriously faulty.

To answer this question, sample topics in the 1000 series were chosen. The average ranking on these topics was taken for the 49 individuals only who had ranked the separate topics. The teacher group was excluded in this test, because the average in question is that for "all except teachers." The results of this test are shown below in table V.

From these data it is seen that there is a slight difference in rank between the two groups but the significance is minimized nearly half by the increase in the probable error, namely $\pm$ .4, resulting from a reduction in the number of individuals from 83 to 49 men. This condition shows that the method used is correct well within any limits imposed by the purpose of this investigation.

TABLE V.

Topic.	Average Rank for Those who Ranked Topics (49 Men).	Average Rank for all Except Teachers (83 Men).	Difference.
1001	32.3	31.4	0.9
1010	27.7	27.7	0.0
1020	48.6	48.2	0.4
1030	43.9	45.5	1.6
1040	39.7	37.0	2.7
1050	30.7	29.8	0.9
1060	24.0	26.3	2.3
		Average Difference	1.3

2. **The Average Rank of Topics.**—The distribution of rankings (A) in tables I and II, also in diagrams I and II show the important condition that the rank interval between topics is far from uniform. That is, the difference in importance between topics which rank as 30 and 31, for example, is not at all the same as the difference in importance between topics which rank as 50 and 51. The interval in the latter case is perhaps four times as great as that of the former. This fact must be kept in mind when considering the rank order arrays in table III, for the units of difference in importance in these arrays have not the same meaning in different ranges of the tables. Therefore, the use of diagrams I and II is to indicate the significance of unit differences of rank (A).

One consequence of the above analysis must not be overlooked, namely, that the reliability of the rankings as expressed in probable error units, is measured by units (A) in tables I and II, and Diagrams I and II. Hence, while a topic may have a given rank (B) with a probable error value of $\pm$ 1.3, it can be seen that this might mean a maximum displacement in the rank order of importance of perhaps 4 or 5 places, or a minimum displacement of less than one place.

3. **Reliability of Results.**—Having established the validity of the method of treatment of the data it remains to show how reliable the results are. This will be done by considering

the probable error of the mean value, which is one of the most commonly used measures of reliability.

We are concerned most with the precision of the rankings assigned the topics by the combined judgment of "all except teachers" and by the teachers themselves. These contrasted arrays indicate any difference in opinion between practising engineers and teachers as to the relative importance of topics in surveying courses. But of course any conclusions will be groundless without having established the reliability of the values in each column.

Accordingly the probable error of the rank number has been computed for random samples selected from each array and the results are shown in table VI.

TABLE VI.

PROBABLE ERROR VALUES FOR RANK NUMBERS.

Topic.	All Except Teachers.			Teachers.			
	Rank.	r_0.	r_m.		Rank.	r_0.	r_m.
1016	5	10.8	1.19	(18 men)	42	10.10	2.38
1023	15	13.0	1.43		19	9.01	2.12
1043	25	11.7	1.28				
1044	35	12.0	1.34				
1040	45	12.0	1.32		64	8.62	2.04
1019	55	9.8	1.08				
1004	65	10.7	1.17				
2044	41	12.8	1.50				
2069				(25 men)	13	8.67	1.73
2066					21	7.47	1.49
2050					40	11.90	2.38
2042					50	12.00	2.39
Average		11.6	1.30			9.68	2.07

These probable error values, as is well known, have the following significance: r_0 denotes the probable error of a single ranking and shows that for any topic in these series taken at random the chances are even that any person will assign it a rank within ± 11.6 units from the average rank (A): r_m denotes the probable error of the average rank number, and therefore it may be said that if another group of 83

engineers ranked these topics, the chances are even that their average rank number would not differ from that determined here by more than ± 1.3 units (A).

If anyone should question the validity of the selection of these topics on the ground that they are taken, all but one, from the 1000 series, the answer would be that the average differences are greater in this series than in the other and therefore this selection makes the least favorable showing as regards the probable error values.

In the case of the teachers' rankings sample topics were chosen from both the 1000 and 2000 series because there was a considerable difference in the number of men in the two groups and it was desirable to have each group represented.

The probable errors for these rankings are larger than for the practicing engineers. But they are not as large as would be expected because of the smaller numbers in the teacher's group. Roughly there are one-fourth as many teachers as practising engineers and we should expect the probable error for the former group to be twice as large as for the latter. This condition leads us to expect a probable error of ± 2.60 for the teachers whereas we find ± 2.07. This means that the teachers' rankings are somewhat more consistent than those of engineers but the final result for the former is not as reliable as that of the latter because of the larger numbers in the latter case.

We can say however from the above facts, that, the differences in rank between the teachers and "all except teachers" is a reliable index of the differences of opinion between the two groups.

4. **Exhibit of Group Topics.**—The topics belonging to the five groups *A, B, C, D,* and *E* in the order of importance may easily be determined by the use of the rank orders given in table III and the arrays of topics on pages 7 to 12. Examples of this procedure are shown below. The A group of topics is presented for each of the four classes:

(1) 83 engineers (1000 series); (2) 18 teachers (1000 series);

(3) 73 engineers (2000 series); (4) 25 teachers (2000 series).

The number of topics to be included in each of the five groups was taken as the average number placed in these groups by the engineers and teachers and was found to be 19, 14, 15, 10, and 11 for groups *A*, *B*, *C*, *D*, and *E*, respectively for series (1000); and 19, 14, 15, 11, and 10 for series (2000).

To make use of the results of this study, it will be desirable for the reader to assemble the topics in the other groups *B*, *C*, *D*, and *E* both for teachers and engineers so that easy comparisons may be made.

ARRANGEMENT OF TOPICS ACCORDING TO THE JUDGMENTS OF 83 ENGINEERS. (ALL BRANCHES EXCEPT TEACHING.)

A

On the basis of MY EXPERIENCE I judge the topics printed on the accompanying slips to be of the HIGHEST value in courses in Surveying.

(Topics are listed in rank order of importance.)

1032 How to keep transit notes. (field)
1052 How to make the adjustments of a transit. (field)
1008 How to relocate lost corners.
1009 How to stake out a simple circular curve. (field)
1016 How to make a survey of a field for a deed. (field)
1021 How to stake out sewer lines and grades. (field)
1059 How to measure the angle between two intersecting lines with a transit. (field)
1025 How to rerun established street lines. (field)
1034 How to carry a transit line past an obstruction. (field)
1039 How to prolong a line by the method of double sights. (field)
1029 How to eliminate errors in tape measurements.
1007 How to locate established lot corners. (field)
1015 How to rerun an old survey from a deed.
1060 How to locate details with a transit and tape. (field)
1023 How to set a transit at a point C which shall be on a straight line between two established points A and B which are not intervisible. (field)

1024 How to sub-divide regular and irregular sections of land.
1022 The student should be given instruction in the proper handling and care of the instrument to protect it from injury. (Does not refer to adjustments.)
1005 How to stake out a bridge. (field)
1010 How to stake out a vertical curve. (field)

ARRANGEMENT OF TOPICS ACCORDING TO THE JUDGMENTS OF 18 TEACHERS

A

On the basis of MY EXPERIENCE I judge the topics printed on the accompanying slips to be of the HIGHEST value in courses in Surveying.

1032 How to keep transit notes. (field)
1022 The student should be given instruction in the proper handling and care of the instrument to protect it from injury. (Does not refer to adjustments.)
1039 How to prolong a line by the method of double sights. (field)
1052 How to make the adjustments of a transit. (field)
1051 How to run an azimuth traverse. (field)
1059 How to measure the angle between two intersecting lines with a transit. (field)
1063 How to compute bearings from angles and vice versa.
1058 How to run a deflection angle traverse. (field)
1044 How to measure an angle by repetition. (field)
1028 The student should be taught the sources and magnitude of errors in tape measurements.
1029 How to eliminate errors in tape measurements.
1062 How to read and determine the least count of any vernier. (field)
1055 The student should be taught what angular errors of closure may be expected in running a transit traverse.
1001 How to measure a vertical angle. (field)
1066 How to keep notes for transit-stadia work.
1064 How to use the transit when out of adjustment so as to eliminate errors.
1054 The student should be taught what checks may be applied to a transit traverse. (field)
1060 How to locate details with a transit and tape. (field)
1034 How to carry a transit line past an obstruction. (field)

ARRANGEMENT OF TOPICS ACCORDING TO THE JUDGMENTS OF 73 ENGINEERS. (ALL BRANCHES EXCEPT TEACHERS.)

A

On the basis of MY EXPERIENCE I judge the topics printed on the accompanying slips to be of the HIGHEST value in courses in Surveying.

2030 How to run a line of profile-levels. (field)
2017 How to set grade-stakes for railway, highway, street, sewer, or sidewalk construction. (field)
2048 How to keep profile level notes. (field)
2047 How to keep cross-section notes. (field)
2004 How to compute cross-section areas.
2068 How to set slope stakes and take cross-sections for earth work. (field)
2056 The student should be made thoroughly familiar with the simplest methods of computing earth-work quantities.
2021 How to eliminate the various errors in leveling; *e.g.*, keep the lengths of backsights and fore-sights equal. etc.
2010 The student should be thoroughly drilled in the various checks to be applied to computations.
2035 How to make the adjustments of the wye level (not peg method). (field)
2012 The student should be given a thorough drill in the systematic arrangement of computations.
2039 How to plot details on a map.
2054 The student should be given practice in making preliminary estimates of earth work from profile.
2025 The student should be well practiced in lettering.
2018 How to compute areas by the method of latitudes and departures.
2033 How to run a line of transit stadia levels. (field)
2019 How to plot a traverse by the method of total latitudes and departures.
2034 The student should be made thoroughly familiar with the details of construction of the engineer's *wye* level.

ARRANGEMENT OF TOPICS ACCORDING TO THE JUDGMENTS OF 25 TEACHERS.

A

On the basis of MY EXPERIENCE I judge the topics printed on the accompanying slips to be of the HIGHEST value in courses in Surveying.

2030 How to run a line of profile-levels. (field)
2048 How to keep profile level notes. (field)
2021 How to eliminate the various errors in leveling; *e.g.*, keep the lengths of backsights and fore-sights equal, etc.

2028 How to make the adjustments of the dumpy level. (field)
2071 How to use the level when out of adjustment, so as to eliminate errors.
2035 How to make the adjustments of the wye level (not peg method). (field)
2012 The student should be given a thorough drill in the systematic arrangement of computations.
2018 How to compute areas by the method of latitudes and departures.
2068 How to set slope stakes and take cross-sections for earth work. (field)
2017 How to set grade-stakes for railway, highway, street, sewer, or sidewalk construction. (field)
2047 How to keep cross-section notes. (field)
2056 The student should be made thoroughly familiar with the simplest methods of computing earth-work quantities.
2069 The student should understand clearly the relations that exist between measured angles and measured distances to secure consistent accuracy in field work.
2004 How to compute cross-section areas.
2010 The student should be thoroughly drilled in the various checks to be applied to computations.
2019 How to plot a traverse by the method of total latitudes and departures.
2033 How to run a line of transit stadia levels. (field)
2008 The student should be made thoroughly familiar with the degree of *accuracy* that may be expected in level circuits.
2032 How to keep the notes for transit-stadia levels.

5. **Summary of Experience.**—The total number of years of engineering experience on which these judgments are based is 1,275 years for the 1,000 series, and 1,615 years for the 2,000 series. These figures show an average of 14½ years' experience by the men who participated. It is of course impossible to determine exactly how many calendar years of surveying experience is represented, but from an inspection of the proportion of surveying to general experience it seems safe to say that a third at least of the total calendar years represent actual surveying experience or the planning and supervision of surveys executed by subordinates. On this basis then we may say that the ranking of these topics represents 400 years surveying experience in the 1,000 series

and 500 years surveying experience in the 2,000 series, or an average of 4½ years per man.

VI. Conclusions.

The facts and data which are exhibited and analyzed in the preceding pages have their chief significance in table III, in the arrays of grouped topics as illustrated by pp. 26 to 29; and in table VI showing the probable errors of the final rankings of topics. It has been shown that the rank order of topics is reliable to the extent that if other groups of equal numbers of engineers or teachers should judge the relative importance of these topics on the basis of their experience only, the chances are even that the resulting ranks of topics would not be different from those given by more than 5 places in the central portion of the series, nor by more than one or two places in the upper and lower quartiles of the series.

It should not, of course, be implied that the rank orders established here are to be considered as final. Various conditions will impose important changes in the order of importance of these topics. However, the combined judgments of these engineers and teachers can hardly be ignored in determining the content of courses in surveying.

SHOULD TEACHERS OF SUCH SUBJECTS AS MATHEMATICS, PHYSICS, CHEMISTRY, AND ENGLISH BE MEMBERS OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION?

Such subjects as mathematics, physics, chemistry and English are fundamental parts of an engineer's training. That they are too often regarded, at least by students, as mere preliminaries to the study of the real (so-called) engineering courses is probably due largely to a lack of understanding between teachers of technical and non-technical subjects. The training in mathematics, science and general subjects needed for engineering is in kind essentially the same as is required for other professions. A certain choice of subject-matter and range is obviously necessary, but the limits of selection are fairly wide. Unnecessary and perhaps misleading importance has been given to "Mathematics for Engineers" and the like. What counts more than anything else is a good teacher, enthusiastic, expert in his own field, constantly growing mentally, who is so well informed in regard to the training needed by his students that he can inspire them with confidence that what they are doing under his guidance is worth while.

Slovenly thinking, inability to write and speak well, inexpertness in the use of mathematics, and lack of knowledge of the simple fundamentals of science are distressingly common faults of engineering graduates. Too often they can deal successfully with technical problems of familiar types, but fail when called upon to solve new problems which require only straight thinking and a thorough grasp of relatively simple fundamentals. Engineering students are prone to look upon the technical subjects as of prime importance and to treat mathematics, science, English and even mechanics as relatively unimportant preliminaries. This state of

mind on the part of the student body is not due to the fact that such subjects are not as well taught as the technical courses, but partly because they seem to the student more abstract, and largely because the students thoroughly understand that teachers with engineering training and experience themselves put a higher value on their own type of courses, that is the technical, than upon the non-technical work.

Fully half, and not the least important part, of the four-year engineering programs, are non-technical subjects which are usually taught by those whose interests, experience and activities are largely outside the technical fields. Nevertheless what they give engineering students is not only the necessary groundwork for a proper handling of the technical courses which follow, but is in fact quite as important if not more so than some of the subjects which students look upon as practical and therefore of more importance. Moreover, the influence of such teachers is, or can be, both stimulating and broadening. They should create a love for science and stir up those activities which make the pure science (so-called) of today the applied science of tomorrow. The work of these teachers could be made more effective if it had more intelligence and more vigorous backing on the part of the engineering group.

The prime object of this Society is to improve engineering education. Its effectiveness and usefulness could be increased many-fold if to its present membership could be added a larger group of teachers of non-technical subjects. Increased contact and discussion between the two groups of teachers would inevitably lead to better mutual understanding and should result in a truer valuation in the minds of both teachers and students of the different kinds of work that make up an engineering training. New and stimulating forces would be set at work in the Society.

H. J. HUGHES, *Vice President,*
Chairman, Institutional Committee.

MATHEMATICS.

In this day of many organizations, the question of membership in each society is serious even to men whose interests obviously lie partly in the field of that society. Many teachers of mathematics in American universities have to do with the education of future engineers. It is to them that this note is addressed.

Mathematics is on trial in this country both in elementary schools and in colleges. Many of the traditional topics and methods will not stand the light of serious educational investigation. To revise our courses wisely we must at least consider the direct uses of mathematics in the outside world. In such a sane revision lies the hope for the maintenance of mathematics in our schools.

It is to engineers more than to any other one class that we in mathematics may look for direct uses of mathematics and for a justification for widespread teaching of the subject, since mathematics does enter directly into practically every branch of engineering. By the same token, it is in engineering that we may find the most vivid illustrations of mathematical principles, and the most obvious demonstrations of the significance of what we teach.

To gain clear ideas of the direct values of mathematics, a teacher can do no better than to enquire into the needs of students intending to study engineering and allied scientific branches. The Society for the Promotion of Engineering Education affords a means for formation of wide acquaintance among engineers interested in education, and for discussion of the mathematical needs of engineers. Membership in the Society is therefore the best available method of getting into touch with this vital side of mathematical teaching.

Reports on mathematical teaching in schools of engineering and papers on specific topics in mathematics have been published frequently in the official journal, ENGINEERING EDUCATION. A committee on Mathematics is one of the standing committees of the Society. The present Committee intends to make

a thorough survey of mathematical courses, entrance requirements, training of teachers, etc., in schools of engineering. Such investigations, reports, and papers, as well as the more informal contacts mentioned above, will well repay any teacher of mathematics for the small investment represented by the dues of the Society.

E. R. HEDRICK,
Chairman, Committee No. 10, Mathematics.

ENGLISH.

There are several considerations which make the membership of English teachers in the Society for the Promotion of Engineering Education a mutual benefit to the teachers and to the Society. My own experience and observation as a teacher of English to engineering students for nearly fifteen years leads me to the conviction that the English teacher needs the Society much more than the Society needs the English teacher, although upon reflection I can see where the influence of such teachers might also be profitable for this organization of engineering educators.

In the first place a teacher of English in an engineering school needs contact with the men who are teaching the more distinctly engineering subjects. He needs to get something of their practical way of looking at things. He needs their sympathy and coöperation in his work, as well as the wholesome check which their criticism, frankly solicited, may furnish him. The time is fortunately past when anyone expects the English courses to supply the only cultural, humanistic influence in the engineering curriculum. Even the responsibility for accuracy in the mechanical details of spelling, punctuation and grammar is now recognized as necessarily shared by all who teach the student in any subject however technical. But surely the best result can only be achieved by a mutual understanding between the instructors in English and those in more distinctly engineering subjects. It is right here that the S. P. E. E. may serve the English teacher especially well. The usual faculty meet-

ing, necessarily given over largely to administrative detail, is not ordinarily an opportune time for the exchange of ideas on educational problems. In most colleges, too, the English teacher unfortunately still feels himself, on most occasions, something of a bystander. But at the informal gatherings of a local group of members of the S. P. E. E., all these conditions are reversed. The very fact that his subject is one demanding the highest pedagogical skill and one which brings him in touch with every student in the engineering college, gives him the assurance to take part in the discussion of problems of engineering teaching and makes his fellow teachers listen to him with respect. Moreover, when the English teacher has thus definitely identified himself with a group of engineering educators, he is bound to find his work regarded no longer as an outside issue but as an integral part of the engineering curriculum. If, as I have personally found profitable, an English teacher can, in addition to his active part in the local branch of the S. P. E. E., attend some of the national meetings of the Society, he will find the opportunity for still further enlarging his circle of acquaintances among engineering educators and for getting a larger understanding of the great problems that confront engineering educators today. Personally I have found the whole experience very inspiring.

At to the contributions which English teachers may make to the Society, I should speak with some degree of modesty. I do think that a larger attendance of English teachers at the national meetings of the Society would serve to stimulate interest in teaching problems and I am very sure it would result in a more intelligent understanding of the relation of English teaching to the teaching of technical subjects. A surprising number of misconceptions still survive regarding what the English courses purport to accomplish. If, for example, I can muster a sufficient force of English teachers at the Champaign meeting next June, I shall hope to lay forever the ghost of that unfortunate misnomer, "Engineering English," and explode the superstition, which dies so hard, that we are purveying a

special brand of our native speech, put up for the particular use of engineering students.

As chairman of the English Committee, I not only urge every teacher of English in an engineering college to join the Society, but solicit suggestions and coöperation in the work of our committee.

J. RALEIGH NELSON,
Chairman of Committee No. 12, English.

PHYSICS.

The instant and obvious answer to this question is:—"No, because the quality of coöperative effort, like the quality of friendship, is not strained!" But there is a delayed and carefully considered answer which every Physics teacher must make for himself, and, as it seems to me, this answer is, in most cases, sure to be:—Yes.

I, for one, do not believe that the American Physical Society can properly concern itself with the problem of physics teaching; and if this is true then the S. P. E. E. is the only organization which can apply itself persistently to this problem.

"Yes, but what has the S. P. E. E. accomplished?" This is the question most frequently asked, and the answer is not flattering to the S. P. E. E. But what can you expect of a society which numbers among its members only a minute fraction of our college teachers of physics?

If I were the Governor of an American college or technical school I would despairingly seize upon membership in the S. P. E. E. by my physics teachers as one slight indication of their interest in their job.

If I were the Governor of an American college or technical school I would look upon membership in the S. P. E. E. as a favorable symptom of convalescence from the malady of self-satisfaction and lazy indifference which is so prevalent among college teachers. Any indication of vitality would be reassuring.

Such tall talk is of course absurd, for college teaching is not hopelessly bad, and in a large sense nothing ever really matters; but very certainly a widespread dissatisfaction with things as they are must precede any constructive work. Join the S. P. E. E. and register your dissatisfaction. Then, perhaps, something can be done.

W. S. FRANKLIN, *Chairman,*
Committee No. 13, Physics.

BUSINESS TRAINING AND ECONOMICS.

"Should teachers of business training and economics be members of the Society for the Promotion of Engineering Education?" yes, by all means, and still more, have them associate with teachers of engineering schools in faculty meetings and otherwise. By such contact there may become a development of the idea that the engineer should be a liberally trained man, one of breadth of view and not narrowly educated in technique only.

I would go further and insist that the English teacher, for example, shall examine everything that the engineering student presents for review, either themes, test papers, or examinations; all for neatness, clearness, diction, grammar, spelling and punctuation. In other words, apply the same test that the business world will apply to technical writings when it passes upon reports. The engineer needs this discipline and it cannot come too early and it must come all the time.

MORRIS KNOWLES, *Chairman,*
Committee No. 14, Business Training.

CHEMISTRY.

"Should teachers of chemistry be members of the Society for the Promotion of Engineering Education?" Yes! Both for the sake of the teacher and those taught. The reasons why a teacher of a basic subject should "participate actively in

questions relating to engineering''—the direct and indirect application of basic subjects—are so manifest that any argument for it seems trite.

1. If a teacher wishes to convince the student that chemical science really *underlies* engineering as much as does physics or mathematics, he should first convince himself—conference with engineers will give enough concrete instances to convince even an ''academic'' professor.

2. If a teacher wishes to put more ''life'' into his chemistry course, he should put more ''life'' into himself—conference with engineers will do this every time.

3. If a chemistry teacher wishes to touch the vital spark to the imagination of his students, let him fire his own imagination at a conference table, with men who are thinking of big engineering problems, and what knowledge is necessary to their solution.

4. If a teacher of chemistry wishes to lead his students to work intensively and systematically with their goal always before their eyes, let him get a clear vision of the goal himself—engineers generally know what they are after, and well trained engineers ''get there''; go with them in spirit.

5. If a teacher wants to teach his men how to study, make them want to acquire knowledge and enjoy the work that is necessary to the climb to the temple on the hill he must first like to climb himself—hill-climbing in company is more enjoyable than trudging up alone; two men can always see more points of interest in the landscape than one. Company can easily transform work into play.

6. It will not overwork one to think up ten more reasons why talking over engineering problems *regularly* will increase the interest of a chemistry teacher, and thereby increase his efficiency. (I have tried to omit that last word, but it would ''slip in.'')

As for the only reasons against it that I have ever heard expressed:

''Can not afford the cost, am already in too many socie-

ties for my purse." Confer more with engineers and you will learn how to distribute the load.

"Have not the time to attend any more meetings." Confer more with engineers and you will learn much about eliminating the unessentials. (Or read Ellis Parker Butler's "Goat Feathers.")

R. M. BIRD.

PRESIDENT'S COMMENT.

The foregoing question, "Should teachers of such subjects as Mathematics, Physics, Chemistry, and English be members of the Society for the Promotion of Engineering Education," addressed to several of the Committee Chairmen was frankly intended to supply propaganda to the Membership Committee. The replies, however, have a much broader significance. They give by direct statement and by implication many of the important practical questions in the teaching of engineering students. In pointing out the advantages which may come to other teachers by conference with the engineering teachers they also indicate the different point of view which the professional engineering teacher may gain through contact with his faculty colleagues. The whole series of statements emphasizes the importance of contact, discussion, conference, coöperation—they indicate the need of the branch meetings in each institution for realizing the objects and the ideals presented by the various chairmen. In industry, the heads of departments in a company confer frequently to determine how their combined effort may result in improving the product. Why should not educators do likewise?

PERSONALS.

Frank Aydelotte, Professor of English at Swarthmore College, has been elected President of that institution. President Aydelotte was formerly Professor of English at the Massachusetts Institute of Technology. He was a member of Committee No. 12, English.

Raymond Walters, formerly Registrar at Lehigh University, has been appointed Dean at Swarthmore College.

William Miller Collier, having accepted appointment as Ambassador to Chile, has resigned as President of the George Washington University.

Howard L. Hodgkins, Dean of the College of Engineering, has been appointed Acting President.

H. M. Raymond, Dean of Engineering at Armour Institute of Technology, has been appointed Acting President of that institution.

John Martin Thomas, former President of Middlebury College, has been elected President of the Pennsylvania State College.

F. Paul Anderson, Dean of the College of Mechanical and Electrical Engineering at the University of Kentucky, has been granted a year's leave of absence. Dean Anderson will direct the work of the Research Laboratory of the American Society of Heating and Ventilating Engineers in the Bureau of Mines, Pittsburgh, Pa.

W. E. Freemen has been appointed Acting Dean to serve in the absence of Dean Anderson. During the past year Mr. Freemen has been Supervisor of Commercial Training with the Westinghouse E. & M. Company at East Pittsburgh.

Hugo Diemer, Personnel Superintendent of the Winchester Repeating Arms Company, New Haven, Conn., has been appointed Director of the Department of Modern Foremanship of the LaSalle Extension University, Chicago, Ill.

Mr. Diemer's division will comprise Industrial Management Efficiency, Modern Foremanship and Production Methods, and Personnel Management.

C. J. Tilden, who has been Director of the Highway and Highway Transport Education Committee, Washington, D. C., since December, 1920, has returned to Yale University as Professor of Engineering Mechanics.

L. A. Scipio, who has been Director of the Research Laboratory of the American Society of Heating and Ventilating Engineers in the Bureau of Mines, Pittsburgh, Pa., since the death of Director J. R. Allen, has returned to Robert College, Constantinople, Turkey.

Secretary Bishop, who was taken seriously ill at the Yale meeting, was confined to his home for several weeks. During his absence from the office, President Scott, in addition to his duties as President, devoted a considerable portion of this time to directing the work of the Secretary's office.

The New York City branch of the Alumni Association of the University of Winconsin has established an annual scholarship of the value of $700 to be known as the "Zona Gale Scholarship"—named in honor of a distinguished graduate of the university—to be awarded to a student who has shown that he possesses special talent of an unusually high order, and who wished to spend all his time in the university in pursuing courses which he thinks will develop his special talent, without being required to complete studies in which he has little or no interest. The holder of the scholarship will not be required to satisfy the regular entrance requirements if he is deficient therein.

NEW MEMBERS.

HUMPHREY, CARL T., Dean, School of Technology, Villanova College, Villanova, Pa.

SECHRIST, GILBERT H., Assistant Professor of Electrical Engineering, A. & M. College of Texas, College Station, Tex.

WIREN, ALEXIS R., General Secretary, Russian Students' Christian Association, 347 Madison Avenue, New York City.

CONSTITUTION AND BY-LAWS OF THE KANSAS-NEBRASKA SECTION OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

Article I. Name and Purpose.

1. The name of this organization is the Kansas-Nebraska Section of the Society for the Promotion of Engineering Education.

2. The purpose is to afford opportunity for members of the S. P. E. E., who reside within the designated territory, to meet for the discussion of problems pertaining to engineering education as they may arise in that region; also to extend by the above means the activities of the S. P. E. E. to the end that the main purposes of that Society may be fostered.

Article II. Membership.

1. All members of the S. P. E. E. residing in the states of Kansas and Nebraska are members of this Section.

Article III. Officers.

1. The officers of this Section shall consist of a President and a Secretary.

2. These officers shall be elected at the annual meeting for a term of one year, or until their successors have been elected.

3. The duties of the respective officers shall be those usually devolving upon such officials. In case of an occasion arising that leads to the necessity of funds for carrying out the Section work, the Secretary shall perform the duties of Treasurer in addition to those of Secretary.

BY-LAWS.

1. *Meetings.*—There shall be held regularly two meetings each year; one to be in either March or April, and the other in

either October or November. The spring meeting shall be known as the annual meeting. The exact time and place of meetings shall be determined by the Executive Committee.

2. *Committees.* I. *Standing Committees.*—The Executive Committee shall consist of the officers of the Section and the Chairman of all other standing committees. The President and Secretary shall be Chairman and Secretary respectively of the Committee.

The Program Committee shall consist of three members, of whom one, who shall be Chairman, shall be elected at the annual meeting, and the other two appointed by the President.

II. *Other Committees.*—There shall be a Nominating Committee of three members appointed by the President at the fall meeting. This Committee shall consider members available for officers and Chairman of the Program Committee, and report at the succeeding annual meeting.

3. *Finances.*—Funds for defraying the expenses of the Section in the conduct of routine business may be raised through the action of the Executive Committee, which is authorized to make a uniform assessment upon the membership, such assessment not to exceed twenty-five (25) cents in any one year. Funds for the carrying out of special enterprises may be raised only by vote of the membership present at a regular meeting.

4. Copies of minutes of the meetings and of any formal papers presented thereat shall be forwarded to the Secretary of the Society.

5. Changes and amendments to the constitution and by-laws may be made at any regular meeting by a two thirds vote of the members present, provided notice of such proposed changes and amendments have been given to the membership prior to the meeting.